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West Europe Report

SCIENCE AND TECHNOLOGY

No. 74

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WEST EUROPE REPORT

SCIENCE AND TECHNOLOGY

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BRIEFS

INTERFERON FROM BACILLUS SUBTILIS--Researchers at the biotechnology company Biogen SA in Geneva have successfully manufactured human leucocyte-interferon by genetic manipulation from families of the bacterium Bacillus subtilis. In addition they cultivated families of the same Bacillus, which produce antigen proteins of the viruses which are responsible for Hepatitis B and foot-and-mouth disease. The development work was carried out in part together with the Centre for Applied Microbiology of the Public Health Laboratory Services at Porton in England. The researchers at Biogen announced some time ago the first manufacture of these products from bacterial families of Escherichia coli (E. coli). In contrast to E. coli, B. subtilis has a number of advantages with respect to the industrial manufacture of products of human or viral genes. For example, B. subtilis does not form any febrifacient endotoxins and can be manufactured more easily in large quantities. Since this bacterium is already in widespread use for the commercial production of enzymes, amino acids and antibiotics, it is of great interest as an alternative organism for the manufacture of proteins such as, for example, interferon. The derivation of leccocyte-interferon from E. coli, developed by Biogen with the Schering Corp., is already at an advanced stage. Clinical tests are planned for this year. [Text] [Duesseldorf EUROPA CHEMIE in German No 15, May 81 p 256] 9581

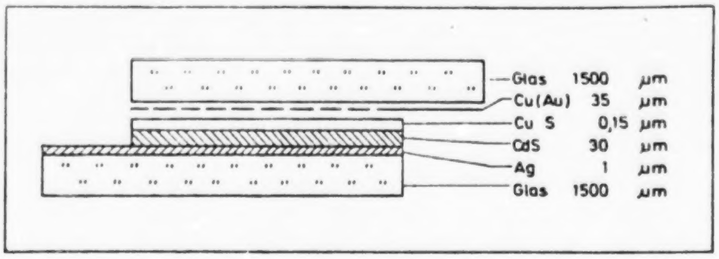
CSO: 3102/381

THIN-LAYER SOLAR CELLS DEVELOPED AT STUTTGART UNIVERSITY

Wuerzburg ELEKTROTECHNIK in German 29 June 91 pp 12, 14

[Article: "Generators Made from Thin-Film Solar Cells"]

[Text] Among thin-film solar cells, the Cu_2-CdS cell is the most highly developed. With large-area cells of this type efficiencies of 8 percent have been achieved at the Institute for Physical Electronics at Stuttgart University. The process developed there for producing large-area Cu_2-CdS cells is based on low-cost processing steps such as high-vacuum vaporization, chemical conversion in an immersion bath, silk-screen printing, etching and galvanic deposition. This makes possible the production of single cells of any desired size and integrated modules on a common substrate with a common covering glass.



The glass upper surface required for long-life solar cells or modules is in this construction, see figure, an integral component of the solar cell or module. The result is a glass-glass sandwich structure which combines high mechanical stability and high resistance to weathering. Add-on base and cover glasses are no longer required.

With an area of 30 by 15 cm and an input power ratio of 100 mW/cm^2, integrated modules for 3 or 6 volts out have an output power of about 1.5 W. Ratioed on the active area, this corresponds to an efficiency of 5 percent. The process developed at the Institute has been taken over by Nuken at Hanau where a pilot plant is presently being set up.

9160
CSO: 3102/386

SIEMENS COMBINES WIND POWER WITH SOLAR CELLS, BATTERIES

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 4 Aug 81 p 5

[Article: "Energy Concept for Small Users"]

[Text] Siemens AG, Munich/Berlin. A noteworthy concept for the independent generation of electricity for small consumption stations has been further developed by Siemens. An example is the energy supply for a TV relay transmitter in Austria. By combining a solar panel and a wind generator to jointly charge a battery, a fully autonomous mode of operation is achieved, according to Siemens. This concept, which is ideal for remote locations, is so designed that a converter can still operate even when there is no sun or wind for a whole week.

The joint energy supply for the TV relay operates automatically in the following manner: The direct current generated by solar radiation in 4 solar panels is fed via a "Sipmos" controller directly to the relay. The panels are connected in series-parallel and provide 24 volts operating voltage at 12 volts per panel. The wind generator produces alternating current with a voltage of 40 to 220 volts, depending on wind velocity. A microprocessor-operated controller varies the turning speed of the generator to achieve optimal power output and connects and disconnects the load. A fuse prevents system damage during a storm. The dc (charge) converter with a high internal efficiency effects rectification and battery charging. The wind-generator blades are designed with diameters of 2 or 3 m depending on power requirements.

The Siemens generators are lee runners--the erection of the blades in line with the wind is accomplished by a ram-jet tube. The specified rated power is 150 W at a wind speed of 5.9 m/s with 2-m blades and 350 W with 3-m blades. At a wind speed of about 1 m/s the blades begin to rotate, and beyond about 4.4 m/s the generator starts delivering power. In developing the solar/wind TV relay, the Austrian Siemens engineers achieved even further economies. Modifications to the 1-W TV relay made it possible to significantly reduce energy consumption, a task which was considerably simplified by the modular construction. When transmitting, the standard design consumes 65 VA while the economical version requires only 40 VA, thus only 2/3 as much. When not transmitting, the modified relay consumes only half as much power as the standard version, reports Siemens.
9160
CSO: 3102/383

SIEMENS EXHIBITS THIN-LAYER AMORPHOUS SILICON SOLAR CELLS

Wuerzburg ELECTROTECHNIK in German 29 Jun 81 pp 10, 11

[Text] Polycrystalline silicon is without competition as a starting material for many electronic components but is presently still much too expensive to make a significant contribution to the energy supply when used in photovoltaic solar cells. Hopes are thus placed on amorphous silicon which could lower the price of solar cells from today's level of about $50 per watt to possibly $0.50 per watt. At this year's Hannover Fair, Siemens exhibited in its special show "Impulses for Frowth Innovations" a type of solar cell with especially thin--and thus material saving--amorphous encapsulation. As in the case of crystalline silicon, the current generating n-p junction can also be produced by doping hydrogen-containing, amorphous silicon. The starting material is produced rather cheaply and with low energy expenditure by decomposing silicon hydride SiH_4 via the corona discharge process. The amorphous silicon produced this way promises efficiencies of from 10 to 20 percent and could also provide the thrust for other semiconductor developments. New thin-film transistors (TFT) are already under consideration. Cell efficiencies achieved to date in the laboratory are in the neighborhood of 5 to 6 percent.

By the corona discharge process being researched at Siemens, silicon can be deposited in such thin films ($1\mu m$) that the cost of the actual semiconductor for solar-cell use is much less than the cost of the substrate. The manufacturer is researching cheap substrates made of steel sheet or plastic foils which are suitable for continuous strips or tapes.

According to preliminary estimates, photovoltaic solar cells for large-scale use could be produced with amorphous silicon which would be up to 100 times cheaper than those made from conventional single-crystal silicon. The price and efficiency of these cells would then lead to competitive energy production costs.

9160
CSO: 3102/386

BRIEFS

ORGANIC TRANSISTOR DEVELOPED--Using a mothball-like material, scientists at the University of Durham in northwest England have developed an organic transistor, probably the world's first. It is based on a thin-film process pioneered by the American scientist Langmuir in 1935. He had discovered that an organic film one molecule thick could be produced by floating the material on a suitable liquid. With a refined version of the Langmuir basin, the British researchers were able to produce an organic film with a thickness of only 1/1000 μm. For this they used anthracene which is closely related to naphthalene, the material from which mothballs are made. [Text] [Wuerzburg ELEKTROTECHNIK in German 9 Jun 81 p 5] 9160

CSO: 3102/383

INDUSTRIAL TECHNOLOGY

EXPANSION OF ROBOT INDUSTRY TO FOREIGN MARKETS

Comau's Automation Methods

Milan SUCCESSO in Italian Jul-Aug 81 pp 37-38, 41

[Article: "Turin, Capital of Europe"]

[Text] It is a well known fact that the American auto industry has had to deal with a crisis of devastating proportions in recent years. Not so well known is the fact that, in order to survive, Ford, General Motors and Chrysler are modernizing their production organization by acquiring technology from Europe and Japan. Among the countries today in a position to sell new machines and advanced production systems, one finds Italy. How come? Because our country is in the vanguard of the field that counts the most: that of automation.

Only 15 years ago, all this would have been unthinkable. But since then things have changed. The oil crisis has rekindled discussions dealing with the entire system of transportation, individual and collective, and has imposed continuous revisions of target quotas by manufacturing concerns. Throughout the whole world, the problem of managing large auto plants has arisen, a process under constant pressure from unions. A crisis which has lasted a few short years has effectively managed to disable a rigid and vulnerable production system, one that was incapable of adapting to the sharp changes of a fickle market, paralyzed by the increasing intolerance of workers, who rebel against dangerous working conditions, conditions that are characterized by repetitiveness and lacking in professional content.

But, paradoxically, it was in those very countries where the crisis was most keenly felt that these new avenues have appeared. Among these countries one finds Italy, where for some time automation has been viewed as a new, fundamental prospect for the auto industry. It is viewed as a kind of necessary choice which finds its justification in a word that has almost magic qualities: flexibility. Flexibility in production organization, flexibility in choice of various market conditions, flexibility in face of increasingly uncertain economic cycles.

There is a company in Turin that has become a symbol of sorts of this worldwide transformation. Its name is Comau and its recent history includes a whole series of diversified interests: one can talk of it as a traditional family album,

linked to the history of Italy's automobile capital, one that was suddenly "married" with one of the most forward-looking facets of the industry, that of automation and industrial robots. Comau was established in 1977 when a group of old manufacturing companies making machine tools, working alongside the larger FIAT combine, formed, from a consortium, a new integrated company bringing together about 10 manufacturing plants, 6,000 employees and a base capital of 300 million dollars. The 1970s were years of uncertainty for machine tool manufacture until the signals emanating from the auto industry became clear. The final word then was: one must change. From a whole series of industries specializing in the manufacture of the most common means of production, machine tools, "the new method of making automobiles" had to emerge. Everyone, industrialists, politicians, union leaders and sociologists were talking about it. This is what they are attempting to do at Comau, and what is more, they benefit from the availability of an essential laboratory nearby in the great FIAT plants in which to test their innovations.

In just a few years integrated systems for production were made, replacing old machinery and the old assembly lines. At the base of the new systems are the wonders of data processing: finding the welding spot using computers and more advanced machine tools, they create something completely new: industrial robots. And by putting everything under the control of a series of computers, which program times and movements, the philosophy of automation has begun to take shape and has started entering the automobile industry's assembly plants.

In order to understand the extent of this innovation, it is necessary to see it at first hand. Probably the most spectacular of the systems created by Comau is the Robogate, a name that is known around the world because of its adoption, not only by FIAT, but SEAT of Spain, Citroen, Chrysler and General Motors. What is Robogate? It is a completely automatic unit that performs all spot welding operations on a car chassis. The chassis mover, which used to hang over the welders' heads, now moves past a battery of robots that weld joints in rapid succession. The robots, that look like elongated arms, capable of various articulated movements, are lined up on both sides of the car chassis mover. As it passes, the arms reach into the car and weld the programed spots with an almost natural elegance. When the mover exits the various stations where the robots are found, the welding process will be completed. Who regulates the whole process? It is a central computer that controls the cars' movement from one station to another, establishes the timetables, keeps track of stocks and supplies and controls the other computers inside each robot.

In other words, the whole working phase is done without manpower and assigned to automatons coordinated by an artificial brain. Most probably this machine will pass into history. Robogate will become as famous as the Jenny, the power loom that ushered in a new era in the history of modern industry. "The spot welding robot," Comau officials explain, "is in effect a revolutionary machine, one of the high points to be attained by second generation robots. But this is not the most important function we perform here. The essential aspect of our work is the connecting of these machines: the result is more than an automaton that performs an unpleasant task for man, but rather it is a system, an integrated, automatic unit. This is the principle that will regulate future manufacturing plants."

To make this automatic process function, only a small number of specialized technicians is necessary. At General Motors, where about 3,000 robots will be installed, plans call for a 50-percent reduction in body work personnel over the next 10 years. But it is not really the prospect of less labor used in manufacturing that acts as a catalyst for the introduction of systems such as Robogate. The real novelty of the system is the plant's flexible nature, which is much more adaptable to the demands of an uncertain market such as the present one.

There was a time when fixed assembly lines shut down for the summer recess to retool for production of new models. The great plants changed production lines in consonance with foreseeable cycles. Depreciation allowances were calculated to within acceptable margins of certainly. This situation no longer holds. The era when large stocks were gradually depleted to make room for a new product has come to an end. Today large automobile manufacturers need ever more flexible plants able to diversify; car models have multiplied and even single models have differing characteristics. The well known aspect of personalizing a car both fascinates and snares the consumer, but costs tne manufacturer money.

The old assembly lines are not able to satisfy these needs for versatility, and it is here that automatic, flexible systems come into their own. A welding line such as that of the Robogate can easily be adapted to produce 10 different models. The computer will program the necessary cycle for the initial work phase, sending coded information to the various robots.

From bodywork to engine building: at Comau, a new integrated assembly system called "asynchronous" has been built. This is due to the fact that employees, instead of working on one assembly line following a given speed, work in operational groups, one separate from the other. Carts carrying engines are conveyed automatically from one part of the department to the other by computer. Between stations, storage areas assure that the system does not jam or get overloaded. A system of this type can be applied not only to the auto industry, but also to TV or refrigerator manufacturers. "Our secret," explained Paolo Cigna director of the automation division of Comau, "is to know how to combine diverse techniques and experiences. We perform well mechanically, because we have been building machinery used by the mammoth auto industry for decades. We have learned how to apply the most sophisticated software to these machines. But in addition to this, it is necessary to have a clear idea of company planning. To link a good piece of tool machine equipment to a good computer and to have everything function properly is not easy. This is where the new relationship has come about, involving the traditional planner, the engineer, who knows how to build a car, and the computer expert. But besides this, we are afforded an extra benefit; namely that of simulating, through use of the computer, the application of a new system in order to immediately spot the limitations and the choke points that can occur during actual operations."

What is the near term outlook for automation as applied to industry? "The new horizons belong certainly to sensoral machines, namely those able to see what they touch and what they do, those eventually able to react in a timely manner to unforeseen events."

Furthermore, Comau can be viewed as a privileged observation point from which to understand how the introduction of systems based on automation in the manufacturing field is proceeding. "There are still difficulties and resistance to change," continued Cigna, "in accepting what is truly a cultural transformation, but it is certain that Italy is one of the countries where companies, especially the larger ones, have for some time taken note of the importance of this new technology. It may appear strange, but I have noticed a greater receptivity to this kind of innovation in manufacturers of our country, where our market presence is more consolidated, than with those of America."

What are the most important developments of these new systems and in which direction will they be heading? "Though some time had to pass, now all have accepted the idea of a computer in the office. This is true not only because it makes sense from an economic planning view point, but it also provides for better labor coordination. In reality, the office computer is a keystone for a new philosophy in production. For the time being, the introduction of software is still sporadic and done in piecemeal fashion. Administrative or warehouse bookkeeping is now perhaps done totally by computer, whereas only a part of production machinery utilizes computers. Today this type of situation is found often even in medium to small size firms. Now, try to imagine a manufacturing plant where computers talk to one another: those that guide production transmit data to those that control warehouse supply and these in turn are linked to terminals in the administrative bookkeeping section. Production, warehouse, and sales data, to include those of retail outlets, could constitute a whole, in and of itself, capable of programing a company's life in a totally new manner. This, to me, seems to be the most important aspect of automation. Of this prospect, industrial robots are definitely an essential part, but still only a part. The final say is still up to man and his capacity to organize and control the entire process."

Robot Type	Italian Market			Balance	Import/Export(*)	
	Pieces Sold	Value in Millions	Employment (by year)	Units	Value in Millions	Employment (by year)
A	1.000	5.000	182	+ 2.000	+ 10.000	+ 363
A°	80	3.200	30	0	0	0
B	80	8.000	116	-40	-4.000	-58
C	100	10.000	145	-50	-5.000	-72
		26.200	473		+ 1.000	+ 223

(*) A minus sign means quantities imported, a plus sign indicates exported quantities.

(A) Nonprogrammable automatic arms; (A°) Programmable automatic arms; (B) Single function robots; (C) Assembly robots.

Contribution by Small Companies

Milan SUCCESSO in Italian Jul-Aug 81 p 39

[Article: "Small Italian Robots"]

[Text] If Italy builds and exports industrial robots, the credit will not go only to the "greats" such as Olivetti or Comau. The success scored by Italian industry in this sector is due in large part to a whole string of small and very small companies. It is these companies that took the plunge, with few means but with many ideas, into the international market of robotics. Which robots are we talking about? Those which are commonly known as first and second generation units: machines used to move material while it is being worked on (pieces for a press or for an assembly phase), robots for painting or automatic machine tools.

Let us take for example the Jobs company of Piacenza, a company that employs about 40 people that produces conveyance robots and machine tools for special tasks. Giacomo Pagani, the company's founder explained: "One-third of what we produce is exported abroad. Our robots can be employed in various functions and are also available to small companies desiring to improve their organization."

The Basfer company of Monza can also attest to the robot's versatility. The company employs 100 people and has become specialized in painting for at least the past 4 years, about the time frame when the auto and household appliance industry began to substitute personnel with robots in what perhaps are among the most harmful work operations. Fifty percent of Basfer's production is sold abroad. (In the United States they formed a holding company with Nordson, which makes use of their patents.) Their machinery can be used in the auto sector (FIAT, Alfa Romeo and Mercedes-Benz use them), as well as by the manufactures of sanitary equipment and of metal furniture. In the field of painting, there is another company that is typical of "the Italian way of robotics." It is called SLS, in the province of Varese. About 10 technicians with an artisan background have perfected a completely automated painting micro-system that permits sand blasting, spraying and metallization. Robox of Castelletto Ticino in the province of Novara also has only a few employees: 23 in all. They include engineers and experts that have applied their experience in software to various tool machines. Today they export 70 percent of their production, mainly to the United States.

The Camel company of Palazzolo (Milan), which employs slightly more than 20 people, manufactures two types of robots: a general purpose unit (for handling and follow-up linking) and a "dedicated" robot, used only for specific tasks, such as at the presses or at the foundry. Together with other small and medium size Italian companies (such as Jobs and Gaiotto), Camel is represented on the British market by Ferrey, which is responsible for the distribution of Italian robots in a country that from an automation point of view, is less advanced than ours.

How can one explain the success of Italian robotics? It is due first of all to two factors: a great tradition in mechanics which has always made our country an exporter of means of production items. (Let us not forget that in the field

of tool machinery, Italy is fifth in world production and the third in export volume.) Second, a marked capacity to adapt to electronic innovations as well as to change in the field of applied research. None of the small enterprises we mentioned has a research department in the true sense of the word, but they all have a bit of the researcher and innovator qualities in them.

Taking the pulse of these companies can give one an indication of how Italian industry is reacting to the advent of automation. Mr Campa of the Norda company in Brescia stated: "We sell to FIAT and to Volkswagen as well as to small- and medium-sized companies that manufacture anything from pans to scissors. We have learned that a company, small though it may be, acquires robots for three reasons: to obtain greater security on the job (by improving the working environment); to be able to plan a specific rate of production; and being able to remove workers from professionally less rewarding tasks and direct them to more satisfying work." Norda, a company that began 10 years ago and has 60 employees, started with conveyance robots and recently introduced a new model, the "Modulo," a versatile machine that takes up little room. (Space has always been a major problem for robot planners.)

Mr Pagani of the Jobs company wishes to dispel the long held notion that only large companies can permit themselves to have robots and to have the courage to introduce them into the office. "At times, fear of making a mistake can affect the bureaucratized staff of a large company more than a small one, while the small company has the courage to run risks. In reality, many large companies do a great deal of research, but when the time comes to apply theory, they hesitate."

Mr Davini of Basfer has a less orthodox point of view: "Large companies now pay great attention to these kinds of innovations. They know that, in the long run, missing certain milestones can cost them dearly. But it is also interesting to see how robots are used by small though efficient companies; we have sold our units to four or five very small companies, which however had enormous production outputs. They have now solved their problems."

The case mentioned by Davini occurs with much more frequency than commonly held in this country, where small and medium industry play such a relevant role. At this point new problems arise because as Mr Castoldi of Camel stated: "Large companies can guarantee maintenance by making use of specialized technicians and can count on a precise planning program." It is for this reason that companies which manufacture robots will find it necessary to improve their service contracts if they want to expand among small and medium size companies. On the other hand, the latter will have to improve the professional quality of their personnel.

9209
CSO: 3102/380

AUTOMATED DRILLING MACHINE TO HELP IN AIRBUS PRODUCTION

Paris INDUSTRIES & TECHNIQUES in French 1 Jul 81 p 28

[Article by A. L.: "Ultra-Precise Automatic Drilling"]

[Text] Ten minutes of machining instead of two days of work. And yet this machine was selected primarily for its precision.

Aircraft construction must automate its drilling operations. The Societe Europeene de Propulsion, in Bordeaux, has just received a special nine-tool machine for fabricating a removable insert: a 1800 mm-diameter crown of composite material, installed in the Airbus jet engines. Up to now, the drilling of internal and external holes, as well as the milling of a slot by hydraulic tracing, were executed by two operators equipped with portable tools. They needed one day to finish one part, with no guarantee of 1/500-th precision and of H7 diameter accuracy for the holes: hence a very long final quality control.

Does this low productivity alone justify the investment in an automatic machine with a single operator? Certainly not, since the plant barely makes ten of these parts per month. But aircraft builders are very sensitive about product quality and reliability of supply; automation assures not only perfect quality, but regular production as well. Moreover, a machining time reduced to 10 minutes eliminates the need for buffer stocks; the manufacturer can fill an unexpected request within one day. The latter advantage becomes primordial if the Airbus fabrication rate increases from four to eight per month, as anticipated. And finally, the general trend toward industrialization in aircraft construction, particularly among nationalized groups, is not satisfied with a large amount of hand-drilling which creates large intermediate stocks and demanding quality controls.

The originality of the Sep machine rests in the tool-bearing arm for drilling the internal face of the crown; it is articulated and moved in the vertical plane by a jack; when not in operation, it rests in its upper position and frees the table which supports the crown. When the latter is in place and clamped down, the arm descends to a horizontal position and is then splined and locked at the center of the table. A step-motor turns the table to 24 successive positions, at each of which the tools held by the arm machine the section of the part which faces them.

Drilling a composite ring.

The fixed external drill and the tracing mill operate at the same time. The articulated arm is one of the major justifications for using an exclusively pneumatic control. Pneumatic tools weigh less and occupy less space; in this case, the single-spindle 0.85 hp head, turning at 5000 rpm, weighs 8 kg and passes through a 64 mm opening.

This machine is the flagship of the Georges Renault pneumatic tool special machine department, at Rueil-Malmaison. For the last three years, this team of some 15 young technicians has been involved with special single- and multi-spindle, small diameter (2/10-th to 15 mm), special drilling and tapping machines. As intense as it is casual, the team is gaining a solid reputation for professionalism. Because most of the pneumatic programs that are being used in the small enterprise have a family resemblance, the team has devised a profitable gadget in the form of a pre-wired pneumatic circuit (block) for a standard drilling cycle. Fabricated in small lots by Chantiers de la Ciotat, it is less expensive than it would be if it were manufactured one at a time, even when one includes the cost for adapting to each special case.

11,023
CSO: 3102/389

NEW THIN-LAYER DEPOSITION PROCESS DEVELOPED

Paris INDUSTRIES & TECHNIQUES in French 1 Jul 81 p 74-75

[Article by Genevieve Coat: "Transparent and Conductive Deposits on Glass or Ceramic"]

[Text] A transparent and conductive metallic oxide coating is deposited by pyrolysis of an ultrasonically-produced aerosol. The layer of several hundreds to several thousands of angstroms is homogeneous.

Traditional coating methods are poorly suited to currrent needs. Vacuum depositions require expensive equipment and very thermally-stable materials, while air spraying does not produce homogeneous layers.

The process recently perfected by Cea (Laboratory for the Study of Thin Materials) is free from these inconveniences. In particular, it assures good homogeneity on plane surfaces, at thicknesses ranging from several hundred angstroms to about one micron.

Among the materials deposited by this process are some metallic oxides with special electrical properties (resistivity lower than 10-3 ohms/cm, for instance), whose use as resistive heating elements imposes itself wherever mist or frost has to be eliminated. However, one of the most interesting applications of this technique is the deposition of indium oxide. From a purely optical standpoint, the thin layer that is formed is transparent in the visible and reflecting in the infra-red. In addition, and depending on operational conditions, this material makes it possible to obtain a whole range of resistances per square (beginning with 7 ohms) which carry an electric power of several watts per square centimeter (up to 30 under particular conditions). Moreover, indium oxide has significant resistance to most chemical agents and proves to be very stable in air and in vacuum! At 180 degrees C in air, no changes occur in the optical and mechanical properties of the coating after 150 hours; under vacuum (10-2 mm of mercury) and at 500 degrees, this duration increases to about 200 hours. At 450 degrees in nitrogen, the electrical resistance increases by 35 percent after 20 hours, and remains constant subsequently. Mechanically, the coatings are very hard and in some cases improve the abrasion resistance of glass. Adhesion is perfect, whether the substrate is glass, quartz, or even ceramic.

This combination of optical and mechanical properties makes this very reliable technique appropriate for very many fields: insulation of building windows, oven windows, driers, solar collectors. But the coating is also suitable for conductive glasses (transparent electrodes), anti-static glasses (electron tubes), and heating glasses (windshield de-icers in planes, contacts, heating tubes, anti-fog coatings for photoelectric cell lenses, transparent ovens for laboratories).

The originality of the process lies in its principle: pyrolysis of an aerosol obtained by ultrasonics. During trials, the deposits were first obtained with laboratory equipment appropriate for small plane surfaces (63 X 63 mm). A moving-belt machine prototype has made it possible to extrapolate to larger dimensions (400 X 300 mm) and to conduct tests, particularly on non-plane photoelectric cell lenses.

The transition to the coating of thousands of lenses with indium oxide has helped to finally perfect the specifications of this type of treatment (1000 ohm resistance with a precision of +/-10 percent). Since then, several modifications have led to industrial development, reducing the number of lenses that are out of specification, accelerating production rates, and improving the deposition yield.

As of now, potential market studies leave no doubt about the future of this technique, especially since it appears to be applicable to the fabrication of thin films of tin, iron, chromium, yttrium, and titanium oxides. An industrial machine presently under construction will be operational in September 1981. It will consist of a tunnel furnace, six meters long, which will have at its center the device which supplies the ultrasonically-produced aerosol. It will make it possible to treat plane or curved glass substrates whose dimensions will reach 200 mm in width and 500 mm in length.

11,023
CSO: 3102/389

INDUSTRIAL TECHNOLOGY

BRIEFS

RENAULT'S SEEING ROBOT--The first shape-recognition robot will be installed in July at the Cleon (Seine-Maritime) plant. Thanks to its camera eye and to combinatorial calculus, it will be able to identify and grasp one of many crankshaft randomly piled on a pallet, and place it in a transfer machine; this apparently simple gesture nevertheless requires no less than 1000 billion operations. "We have 4632 intelligent handlers in our group as a whole," explains Mr Jean Lagasse, director of scientific and technical affairs, "and if the Japanese claim to have 46,000 it is because they count all the simple automatic devices which have been in use here since the 1950', and which are not real robots at all, when the latter are defined as 'articulated and programmed mechanical systems which are capable of adapting themselves to their environment.'" The programmation of a flexible shop--the most sophisticated form of robot--requires three to six months, and through simple program modifications allows the integration during operation, of technologic innovations or new market demands. [Text] [Paris AFP SCIENCES in French 25 Jun 81 p 17] 11,023

CSO: 3102/389

'AXIAL' ENGINE RATES HIGH IN EFFICIENCY, PERFORMANCE

Paris L'ARGUS DE L'AUTOMOBILE in French 16 Jul 81, p 8

[Unsigned article: "The Brille Engine: Revolutionary and Economical"]

[Excerpts] Automotive reporters are regularly importuned by strangers who claim to have simply reinvented the automobile, or improved the Carnot cycle! Unlike them, Mr Brille, inventor of an axial engine, has never importuned anybody, and receives only esteem and respect from his colleagues in the Automobile Engineers' Society, his 30 years of research at Citroen and Renault speaking eloquently on his behalf.

Since his retirement nine years ago, he has been using his own resources to perfect an axial engine. He would gladly call it a tumbler engine if the term had not become somewhat devaluated over the years, many inventors having proposed engines of this type, whose mechanical efficiency turned out to be so poor that they have discredited this tumbler configuration, which resembles that of a revolver's tumbler, where the rotation shaft is parallel to the axis of the engine's cylinders.

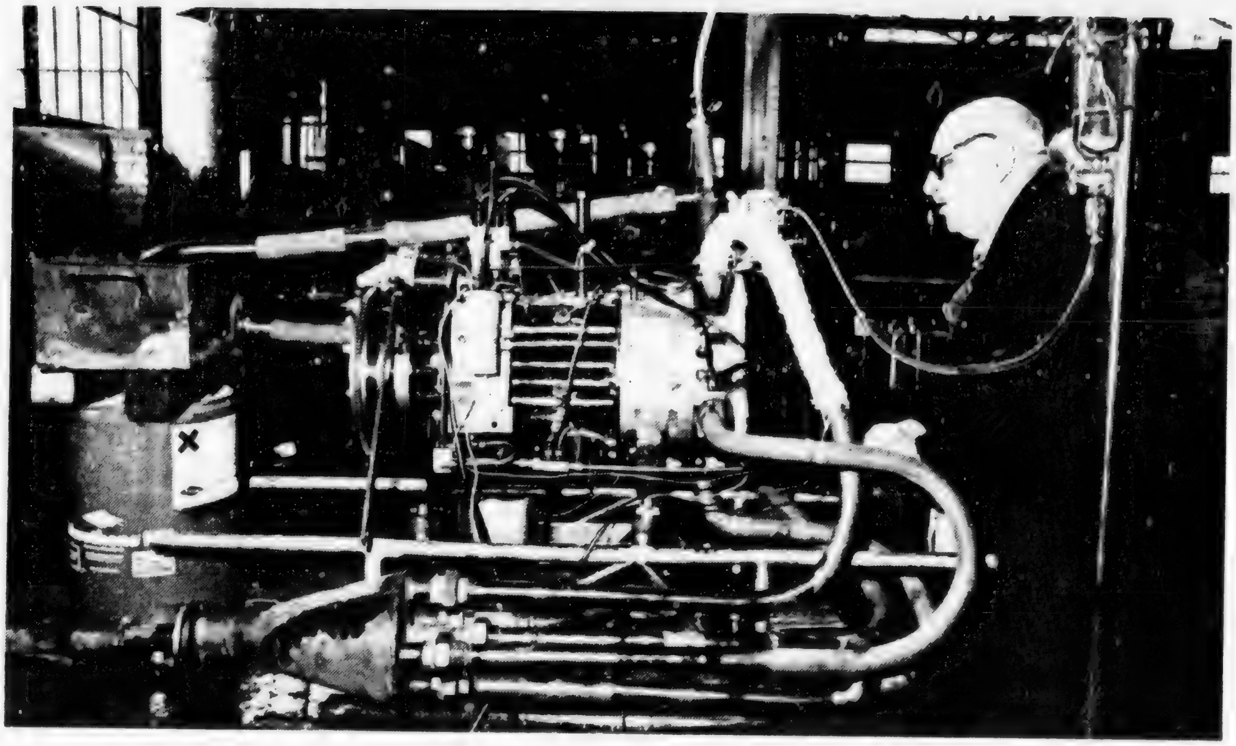
The axial concept for a thermal engine is so obvious that the first person to have used it was James Watt. We can thus clearly see that while the idea is an apparently simple one, its construction is much less so. The Brille engine combines several fundamental advantages:

The tumbler concept, is synonymous with compactness and light weight, provided it is well carried out;

Excellent mechanical performance: the Brille engine with 5, 7, or 9 cylinders, will in all cases have only two main bearings and a single rod bearing consisting of ball-bearings, thanks to a crank system based on the geometry of cones, and to a central pivot with conical gears (ring-shaped);

Minimum friction coming only from the piston movement in the cylinders, and further reduced by the approximately conical movement of the pistons, and the near absence of lateral thrust, resulting from the minimal inclination of the piston rods, amounting to 2 degrees at most;

A major innovation in piston engines, the Brille concept makes it possible to easily vary the compression ratio automatically or manually, by axially displacing the crank-rod-piston assembly by 10 to 20 percent of its travel without additional friction.



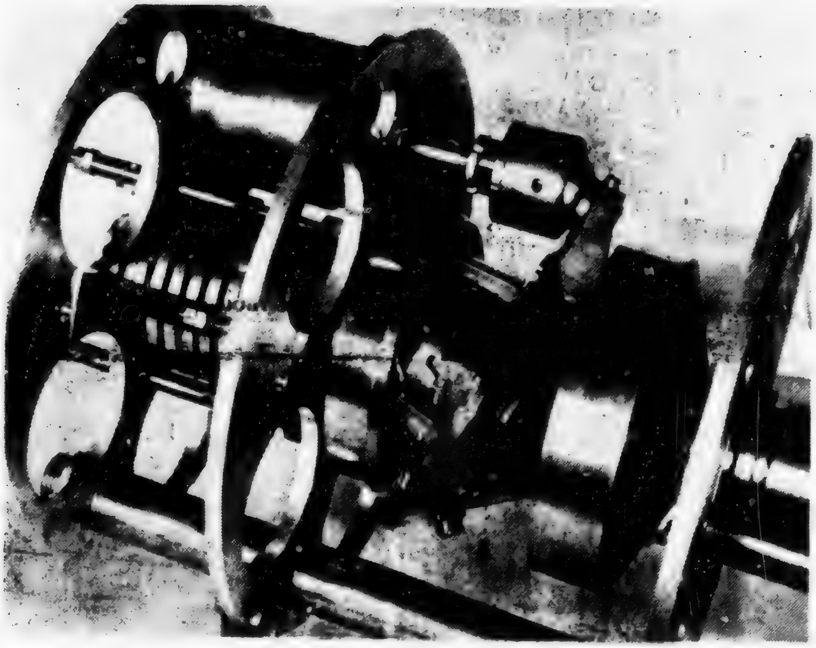
Maurice Brille with the motorized model. On the right, the original head milled out of aluminum. The central portion (black) is the machined and welded engine block. On the left, the ignition, starter, and flywheel. It can be seen that this model can be readily shortened into a final engine.

Successful Synthesis

In addition to the structural advantages of the Brille engine, the variation of the compression ratio effectively bridges the most recent innovations in thermal design (combustion chambers), and the old dream of all engine designers: not only to make engines accept a number of fuels, but take advantage of the variable compression ratio to optimize engine efficiency regardless of circumstances. The most obvious example is the cold start (a really cold one, rather than at 20 degrees centigrade as in official specifications!), where an increased compression ratio provides an efficient solution to (rapid) engine warmup. In short, the Brille engine is actually the only one which makes it possible to maintain the combustion mixture at optimum temperature before expansion, and consequently to maintain thermal yield at maximum efficiency in every case, and notably at partial load: like it or not, one of the main advantages of diesel engines vanishes with Maurice Brille's variable compression, axial gasoline engine.

As Far As It Will Go

The design of tumbler engines has always failed between the piston rod and the power takeoff shaft. To enumerate all the systems conceived so far would amount to an encyclopedia of solutions which use cylindrical cams, fingers or rollers set at an angle to the shaft, cams (including Mitchells), and Z-cranks with oscillating disks;



This view of the first manual model for kinetic verification, equipped with a single piston rod, clearly shows the simplicity of the Brille system design.

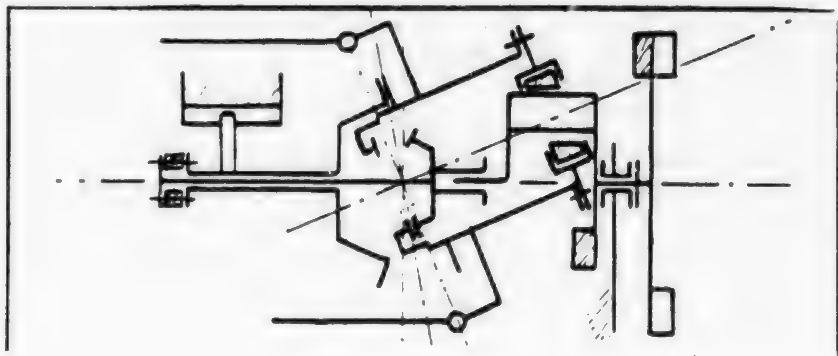
none of them is really effective. On the other hand, the only solution based on a conical geometry (rather than on a spherical one), proposed by Brille and recognized as original by the La Haye International Patents Institute, makes it possible to replace pure sliding with a nearly pure rolling motion, with excellent efficiency.

In this axial engine, the dish attached to the piston rods acquires a simple vertical back-and-forth motion at its outer edges (the cylinder axis is considered as vertical in drawings 1 and 2): the shallow part of the dish, point 2 of drawing 1 and point 7 of drawing 2, traces an approximate circle that can be utilized by the crankshaft.

The cleverness of the system is that it pivots around a virtual point S (figure 2), thanks to a group of crowns with large teeth, which block the up-and-down motion of the system as the teeth brace laterally against a rail for a perfectly circular drive. While it might be difficult to intellectually digest this solution, it appears very simple as soon as it is seen. Four large toothed crowns alternately approach each other without ever turning: a sheet of paper inserted between their teeth demonstrates the total absence of sliding, which is replaced by rotation.

All Is Ready

The quality of the preliminary work has drawn attention to the Brille engine. ANVAR (National Agency for Implementation of Research) and DGRST (General Delegation for Scientific and Technical Research) have lent their support to the project: the original calculations were thus rerun and perfected on a computer, and many students at Arts et Metiers have developed a great interest in this problem. A working



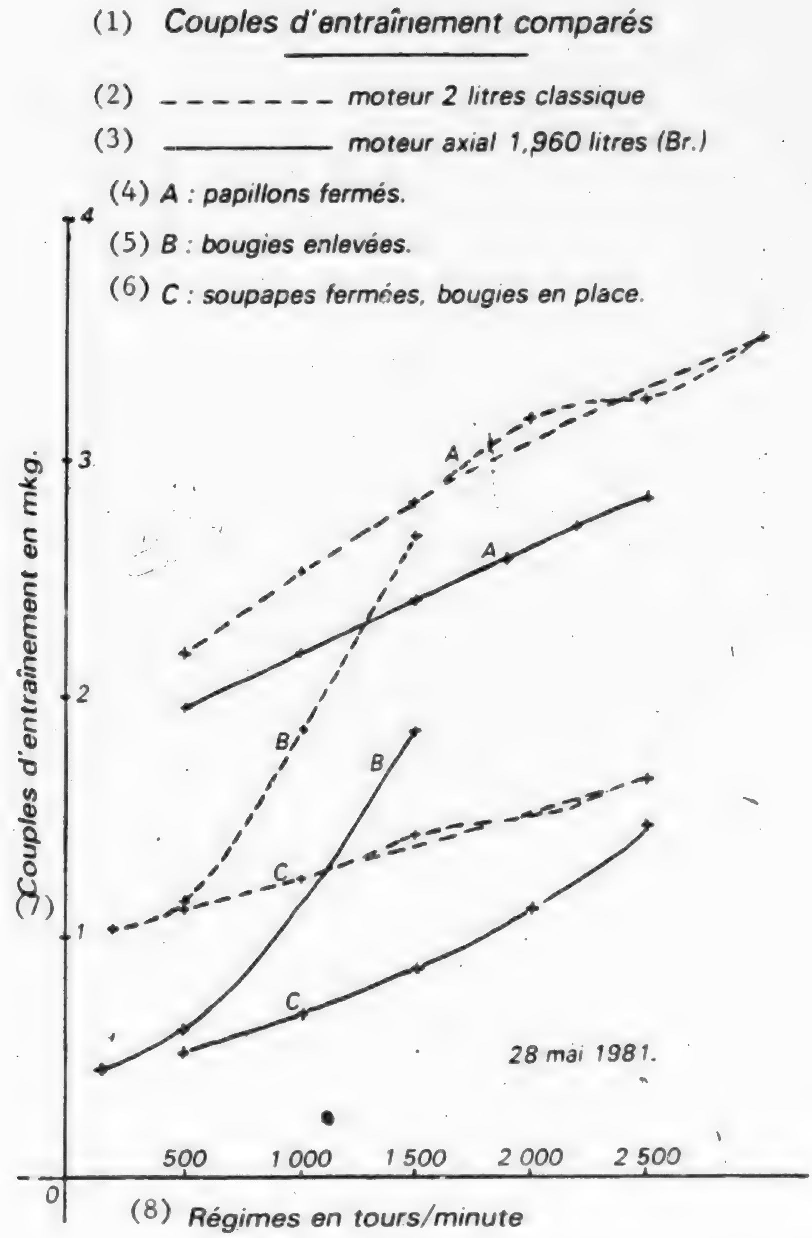
Latest version of the Brille engine. The crankshaft drive system and the dish construction have been significantly changed: the engine has become more reliable, and easier to install and manufacture.

engine which has not yet been built for lack of means, is therefore perfectly optimized in terms of calculations, and since many engineers have participated directly in its design, a virtual team is now available to Mr Brille, ready to undertake the development of the project.

Quite naturally, many companies are interested in the project, especially in Germany, but they are all waiting for figures to prove the soundness of the theory. This has now been done, and the comparative drive diagrams obtained at the National Test Laboratory with an engine model that Mr Brille deems unworthy because it is so far removed from a true model, show that the inventor was right. Compared to an excellent two-liter engine as reference, this fragile mock-up is already superior (see curves). However, Mr Brille did not wait for these tests to design an engine that is really suitable for mass production: patented by now, it revives the principle of radial engines (very simple and inexpensive), and has reduced the initial angle of the dish to 18 degrees (computer optimization) from the original 22 degrees and 30 minutes dictated by obvious requirements for design simplicity. This 7-cylinder engine, shorter than a conventional 4-cylinder one, offers a large number of advantages while retaining a similar price range, which is essential and already calculated.

To Be Continued

Public support, effective so far because it financed a collaboration with the university, will be continued only if an industrial enterprise will undertake to support Mr Brille, who cannot continue to perfect the engine out of his own resources. Let us hope that this happens soon: it would be so desirable for this solution to remain a French one.



Each engine, the 2-liter, 4-cylinder in-line reference engine, and the Brille tumbler engine, are driven by a motor. Three series of measurements, butterflies closed, spark plugs removed, valves closed-spark plugs in place, were performed. The third test is the most significant by far (curve C) and gives an undeniable advantage to the Brille engine. Large oil suction in this--very tired--engine has prevented its reaching full power.

Key:
(1) Comparative drive torques
(2) Conventional 2-liter engine
(3) 1.960-liter (Br.) axial engine
(4) Butterflies closed
(5) Spark plugs removed
(6) Valves closed, spark plugs in place
(7) Drive torque in mkg
(8) Revolutions per minute

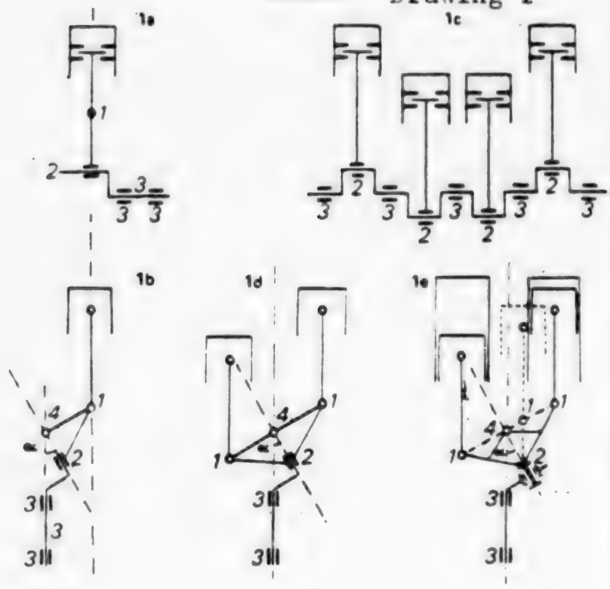
Already valuable for cars, the tumbler engine is equally as useful for a number of gasoline or diesel, civilian or military land applications, and even more so for aeronautics: the axial layout of the cylinders and the power increase obtained from the variable compression ratio, are perfect for aviation (notably takeoff and landing). We have watched the poor, tired model operate with "mayonnaise" (water mixed in oil) without stopping; this provides additional reliability for users.

Turbocompressors, far from being incompatible with the tumbler structure, are beautifully adapted to it. So much so that it was one of Mr Brille's initial ideas, since the arrangement of the cylinders encourages the central location of a turbine: it takes advantage not only of the kinetic energy of exhaust gases, but also of their blast effect. In point of fact, the present engine has a circular intake manifold where it was noted that the burned gases turned in a direction opposite to that of the engine. Clearly, much remains to be discovered and great benefits can therefore be derived from an engine which already outclasses in-line engines thanks to variable compression, eliminates the choke, and consumes 50 percent less fuel in congested traffic.

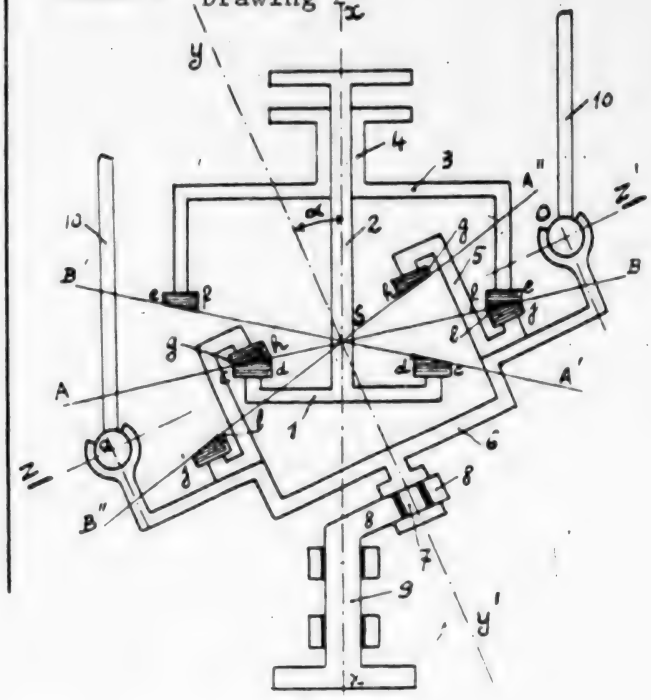
Tentative Conclusion

While basically attractive, the tumbler configuration had fallen in disrepute because no one had been able to come up with a reliable and efficient crank design. The great virtue of Mr Brille's concept is that it offers a simple and efficient system which opens enormous opportunities to those who produce or use internal combustion engines. It so happens that the invention is a French one, and it is up to us to take advantage of it.

Dessin 1 Drawing 1



Dessin 2 Drawing 2



The Brille engine: a complex theory, a very simple system.

To explain the principle of motion conversion, we called on a specialist, Mr Brille himself, by reprinting extracts from the paper he read at the FISITA Congress in May 1974.

Drawing 1

Sketch 1a shows a single-cylinder engine. In order to bring the axis of the engine parallel to the axis of the cylinder, the piston rod is broken at point 1 (sketch 1b); its lower portion remains connected to crank 2, which is bent at an angle of 20-25 degrees to the engine shaft 3; the engine shaft is now parallel to the axis of the cylinder. The thrust of articulation 1 is received by a triangulation bar attached at 1 and 4, the latter point being located on the extension of shaft 3 at the intersection with the extension of crank 2. With the rigid triangle 1-2-4 turning around point 4, and as long as point 1 is maintained essentially in the figure plane, engine 1b operates like engine 1a.

In 1b, the axial displacement of the assembly can occur by maintaining the cylinder and the bearings of shaft 3 fixed as part of the block; this makes it possible to vary the upper position of the top of the piston with respect to the head of the cylinder, and thus to vary the compression ratio. But the cost of this advantage is rather high in terms of significant complexity and of additional friction at pivots 1 and 4.

The picture changes when we move to multi-cylinder engines, and the advantages of the axial type become more evident as the number of cylinders increases. Sketches 1c and 1d show the transition to four cylinders. At this point, 1c has nine bearing surfaces while 1d still has only three, which actually work scarcely harder than each of the earlier ones. Moreover, they can be ball bearings, a favorable factor which is not really feasible for the crankshaft of 1c. In space, the triangle 1-2-4 now becomes the solid 1-4-1-2, or pivoting dish, where line 1-1 is a circumference on which the four piston rods articulate. In this case there are eight pivots, plus the central one. Since friction losses are especially large in bearings, particularly at high speeds, the advantage of 1d over 1c then becomes evident as long as the pivots are handled so as to maintain very low friction.

Configuration of Dish

While maintaining its rigidity, the dish can be configured (sketch 1e) to allow larger clearances, with a freer articulation 1 and a pin at 2. To avoid misalignment constraints, pin 2 must be axially restrained in both directions in its bearing, which in turn is mounted as a ball-socket on the crank; after installation, this ball-socket has no further relative motion with respect to the crank.

Drawing 2

Simplified sketch of the kinetic verification model. The angle alpha is equal to 22.5 degrees. The dish (6) is maintained in place by the teeth of crowns 1 and 3, which are clearly mobile and can be moved vertically, with the result that the rods (10) and their pistons can be raised to increase the compression ratio.

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DORNIER'S DO 228 COMMUTER PROGRAM REVIEWED

Stuttgart FLUG REVUE in German Aug 81 pp 49-52

[Article by Helmut Penner]

> [Excerpts] With DM 15 million in support from the Ministry for Research and Technology, the Dornier company began an experimental program which, after 6 years, has for the moment reached a successful conclusion with the maiden flight of the Do 228-100 and Do 228-200 prototypes. If the South German company had been active until now only in the utility sector with the Do 27, Do 28 A and B and the Do 28D Skyservant models, it now wants to push ahead into the commuter market with the 228 series. So far there have been 31 firm orders and 83 options for the Do 128/228 family.

Starting with the fuselage-tailplane configuration, the 228-100 is given intermediate fuselage sections--each 762 mm long--which are inserted in front of and behind the wing area and which lengthen the fuselage, the nose of which was newly developed for the twin nose wheel, by 3.34 ms and 4.68 ms respectively.

There were problems in the redesign of the nose landing gear for low-pressure tires. At first the TNT New Technology Wing used production landing gear from the Alpha Jet, slightly modified for the production aircraft. The narrow track made a stop-gap solution necessary, which used slight negative camber to gain a few extra millimeters. In contrast to the old versions, the designers found that they had to design the landing gear to be retractable, which naturally led to additional solutions to these problems. The newly designed main landing gear can be housed in pods built into the side of the fuselage structure.

The tailplane unit is taken over unchanged from the 128 series.

It appears to be a negative factor that with the new fuselage design the cabin cannot be pressurized, as the service ceiling is quoted as only 9,020 ms, and service ceilings which may be up to 15 percent lower than those of competing designs can be attained. Dornier would like to avoid this problem with a later 30-seat version, designated LTA. Since the airplane will be used principally on short routes, in spite of its tremendous range of 1,150 to 1,970 kms, not quite so much importance attaches to the attainable ceiling.

The power output of the 2 Garrett AiResearch TPE 331-5 engines, of 715 SHP [Shaft Horsepower] each, gives the aircraft a takeoff run of 526 ms and a climb rate of 10.4 ms/sec, due also to the additional lift devices. Pratt & Whitney PT6A-135 turbines of 750 SHP and PT6A-41 turbines of 850 SHP are planned for use in later versions.

The wing, which is basically identical to the TNT wing, is the same in the 228-100 and the 228-200. Experts believe that the NC New Construction machining process developed for the first time for the wing section, and which is being applied in a simplified form in components of the Alpha Jet, will result in a great cost reduction. The sections, consisting of an upper and lower surface and machined from a single piece of aluminum, are shaped to their predetermined profile in presses and riveted only at the leading and trailing edges. This is a manufacturing process which has never previously been applied in aircraft construction in this way, which can bring enormous savings in work hours and which can point the way to the future in aircraft construction. Some of the wing leading edges and wing tips have structures of carbon fiber.

The overall design of this plane, costing DM 2.7 to 3.0 million, which falls into the 5.7-ton weight class, is intended to increase usable weight capacity, and this was achieved primarily with the new wing. Compared with conventional designs, this means an increase of 25 to 40 percent and a fuel savings of up to 30 percent. In addition, the design provides for an increase in cruising speed and a phenomenal rate of climb in spite of the increased takeoff weight.

On the basis of its good performance the ability to operate from high-altitude airfields is especially pleasing. With a cruising speed of 400 kms/hour the number of operations can also be increased compared with other designs. If Dornier had previously directed itself only to the utility application of aircraft, for the first time it had to adhere to the standard of the commuter users. The conformation of the cabin, which the rectangular fuselage cross-section does much to help, was the subject of especially long deliberation. Convenience and comfort for the passenger are of primary importance. The seats are separated by a central aisle. The double passenger loading door in the rear fuselage section, with its built-in stairway, allows easy entry and loading. Additional baggage capacity is available in the nose to supplement the rear baggage space.

First Production Aircraft at the End of 1981

The first production machine will be delivered at the end of this year following model certification. Monthly production is planned at five units. Preparations have been made at the Dornier works to aim at an initial total production of 300 aircraft.

The airplane, which has been designed for a total life of 24,000 hours--this is the equivalent of an operational life of 15 years without repairs to the primary structure--was developed to comply with FAR [Federal Air Regulations] Part 23 and SV [Safety Regulations] 41. The class of buyers concerned, primarily relief airline companies, will in future have to examine closely what they are getting for their money. One thing is clear: There is as yet no direct competition for this quiet, extremely economical, modern-style short-takeoff aircraft.

First Results of the Test Flight

Following the first test flights, Dornier test pilot Dieter Thomas stated that all the expectations that had been held concerning the aircraft had been fulfilled. Some of the calculated levels of performance had already been reached in flight. Flight characteristics were satisfactory, and the systems would still have to be tested individually. The first impression was extremely positive. It was thought that certification of both versions could be granted after 100 to 120 flying hours, which would mean a considerable reduction in time compared with traditional certification procedures. Thomas named two deadlines: 17 October 1981 for the 228-100 and 23 December 1981 for the 228-200.

Dieter Thomas gave an interesting pointer: The Hoffmann Propeller Construction company in Rosenheim is working with the Dornier company on a special propeller under an experimental program. Initial results indicate an entire new generation of propellers. The OLGA turbulence reduction system will likewise improve passenger comfort. As a result of the partially lower operating heights when flying at lower levels, the aircraft is occasionally subject to stronger turbulence than aircraft flying at greater heights. The OLGA system promises to make aircraft operating in commuter service more comfortable for the passengers.

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TRANSPORTATION

DORNIER EXHIBITS EFFICIENT, ECONOMICAL 228 COMMUTER

Gelsenkirchen AEROKURIER in German Jun 81 pp 704-706, 708, 710, 712

[Article by J. Doerpinghaus: "Do 228-100/200: The First Time With a New Technology Wing. Dornier is Betting on the Commuter Market"]

[Text] They carry the show numbers 001 and 002 at the Paris Air Salon, the two new "Utility" and "Commuter" models from Dornier, the Do 228-100 and the Do 228-200. Thus the FRG is represented at the Paris Air Salon by two genuinely new exhibits, so new that both aircraft together had probably completed scarcely 50 flying hours on their arrival in Paris, including the transit flight from Oberpfaffenhausen to Paris. Both models, which reveals hardly any signs of their historical kinship with the Skyservant, have been designed for one of the fastest growing markets in air travel, the commuter market and the so-called third-level feeder and short-haul aircraft market. According to U.S. prognoses, this market will increase by 10 percent annually, while other markets in air travel are tending, if anything, toward clearly smaller growth rates. The principal technological feature and also the principal sales argument for the new 228-family is the new-technology wing, "TNT" for short. In fact this abbreviation conceals some brilliant ideas, a new, extremely low-drag profile, a wing plan very close to the ideal aerodynamic shape and a wing structure that is new both in construction and manufacturing technology.

The new wing also holds the secret of the extraordinary performance which the Dornier can achieve, in spite of engines that are, if anything, of only average power for its size.

While the smaller Do 228-100 has space for a total of 15 passengers, the 228-200 can carry a total of 19 passengers. For reasons affecting registration and customers' operating licenses, both aircraft have a maximum takeoff weight of 5,700 kg.

However, the design offers sufficient technical reserves to increase the maximum takeoff weight substantially at a later date.

It was the performance, or more precisely, the performance, purchase price and the expected economy of operation together which attracted attention worldwide after the announcement of the 228. This is true both of potential customers and also of other manufacturers, who are so impressed by the expected performance of the TNT that Dornier is said not to be short of offers to cooperate. After mature reflection the company decided to see the Do 228 through alone, under its own direction. The correctness of this decision has been confirmed by two successes: the incredibly short time in which the two aircraft went from the drawing board into the air, and the confirmed sales and options that were received even before their maiden flights, which seem to give the old-established company every reason to hope for a solid market success. According to unofficial statements, Dornier likes to be extremely reticent in this respect, more than 20 aircraft have already been definitely sold. There are already options on another 35 machines, and all of this before the aircraft flew for the first time, before it was really known internationally. Preparations are already under way at Dornier for a 1st production run of about 50 aircraft. The preparations for production as well as construction of the prototypes are being pushed ahead vigorously, because the company wants to preserve the time advantage it already has.

The commuters are coming: a class of airplanes which a few years ago would have been assigned an outsider's role at most is wakening to new life: the feeder airliners and small commercial aircraft for second-and third-level air travel.

The demand for airplanes in this category has jumped worldwide. Manufacturers of suitable designs have been unable for some time to keep up with deliveries at the same speed as market demands for aircraft in this categor . The reason: traditional airline transportation is in a deep-seated international upheaval. Because of the recent explosive rise in fuel prices, the airlines can use their large machines only on those routes that guarantee high seat occupany for the entire flight. Even more, smaller and older airplane designs are being withdrawn from service prematurely in a program of so-called route and frequency cleanup and are being replaced by larger and/or more modern equipment with which passenger-miles can be achieved at favorable rates. The consequence: more and more air connections are being cut and flown less frequently because the number of passengers is not sufficient to fly a DC-9 or a Boeing 737 and cover costs. Added to this are the high takeoff and landing fees, airport handling and flight insurance services that the airlines have to pay for the operation of their large aircraft and which are driving the breakeven factor even higher, that is, the point after which the demand on a route is sufficient to fly with a particular design and cover costs.

If, in earlier years, the big airline companies could afford to operate at a loss on certain routes in the interest of the traveling public, such possibilities are almost nonexistent today, since most of the airline companies are operating in the red, not a few are hardly able to meet their payment obligations to the aircraft manufacturers and some are no longer even financially in a position to accept the airplanes ordered from the manufacturers and now ready for delivery. Against this backdrop, the airlines have no option but to cut the routes which they cannot fly and cover costs with their equipment. The consequence for the flying public is that fewer and fewer cities can be reached less frequently by airliner. This development is already most pronounced in the United States, which, in conjunction with the prior deregulation policy of President Carter, has undergone a major upheaval it its air traffic structure in the last few years. This development can now be observed in Europe in a somewhat different context and under different conditions.

The economy, however, needs the airplane, the rapid air link, more than ever today, independently of whether enough "filier-passengers" fly to fill a full-size airliner. In all the places where the large airliners are forced to withdraw because of insufficient capacity, smaller companies on the feeder and short-haul level--now called "commuter" for short in modern German--are struggling to gain an entry in the gap left by the large carriers.

The secret of their success: they are operating with equipment in the range up to 20 seats, a number that can easily be filled. Higher demand is usually compensated for by a higher frequency of flights. There is great flexibility here. The only problem for these commuter airlines lies in the airplanes, or more accurately, the aircraft which cannot be bought at the moment, or not in sufficient numbers, and which are based anyway on the technology of the 1960s and 1970s, at least as far as the airframe and aerodynamics are concerned.

American studies talk in terms of an average growth of the commuter airlines for the next 10 years of more than 10 percent annually. Such growth rates have become rare in presentday air traffic.

In Europe too, there is a strong demand for airplanes in this category, not only to be able to continue operating unprofitable routes, but also to be able to start flights on routes between so-called medium-size centers--particularly across international frontiers--to the extent that political arrangements can eventually be reached about this.

Dornier is taking precise aim at the feeder and short-haul route services with the new 228-family, which is being presented publicly for the first time at the Paris Air Salon. The remarkable thing about the new Dornier commuter program: after the German aviation industry spent far too much time pursuing the idea of the "market gap," which it thought it had to find in order to ensure success, Dornier is planning to enter a hotly contested market, a market which is not a hypothetical market between other markets, but which has been discovered in the meantime and attacked by many manufacturers, thanks to its demand potential.

Dornier is putting itself squarely up against international competition.

In order to successfully meet the competition, which is well established in part, Dornier has come up some technological ideas that were nonexistent in this category of aircraft previously. Particular mention should be made of the spectacularly low-drag and energy-saving:

--new technology wing and, integrated into the design,

--manufacturing knowhow, which had been previously applied only to high-performance aircraft. Last, but not least, through long-term, goal-oriented and well thought out preparation of the project on the research side, Dornier can offer not only a substantial lead over the competition, but also,

--extraordinarily favorable prices, which should be particularly attractive to the smaller companies which are in many cases weak in capital.

It is no surprise that interest in the new Do 228-family has awakened worldwide, and that Dornier--just a few weeks after the maiden flight of both prototypes--can cushion itself on a volume orders that is unusually high by European aircraft construction standards.

The first two production machines will stay in Europe, which is not a matter of course, given Dornier's traditional good relationships with Third World markets. Production Number 1 is going to a Scandanavian customer, while the second aircraft is destined for a company based in Switzerland.

As the group designation Utility/Commuter for the 228-100 and 228-200 shows, the new Dornier family is designed for a broad spectrum of use. Naturally, passenger traffic on short-haul feeder routes is of primary concern, as well as links between so-called subcenters, which would otherwise be left without any air traffic connection. Both models are also suited for all kinds of freight transportation, for dropping parachutists and for SAR (Sea-Air Rescue) service. Because of its excellent fuel consumption, the 228 is also suitable as a flying laboratory and for patrol duties at sea, for example, for coastal and fishery protection.

Initially, both models are being equipped with Garrett AiResearch TPE 331-5 [as published] engines, each producing 534 kW (715 SHP Shaft Horsepower). Dornier is considering offering both models at a later point in time with PT6 turbine engines, given sufficient customer interest.

A Realistic Philosophy

There was once a time when pretty much each year one manufacturer or other presented a design, which, it claimed, was the ideal successor to the DC-3. As is known today, no one design--with the possible exception of the F-27-- has successfully followed in the steps of the DC-3. Until this day the DC-3 has remained its "own successor."

Something can be learned from this story, and perhaps Dornier had some of this knowledge in mind when the 228 was designed.

First there is the fact t the customers for airplanes in this category are mostly smaller companies, ..ich simply do not have the capital to use expensive equipment, but are glad if they can just pay for machinery at the best price.

Practically all the successors to the DC-3 failed because they were much too expensive in comparison to the model they were supposed to replace.

So it was clear to Dornier that the 228-family had to be designed as cost-effectively as possible so that it could actually find a place in the market.

Low operating costs are in fact even more important than an initially low purchase price.

With the new-technology wing, Dornier is competitive in this area as well. The Do 228 will use considerably less fuel than a comparable aircraft of the same size with a conventional wing design. The saving in fuel alone is quoted at about 30 percent, which, with today's kerosene prices, will result in an enormous benefit on the operating cost side. It it is assumed that today it is often sufficient reason to change equipment if fuel consumption can be decreased by 8 or 10 percent, then one can see what kind of step forward the Do 228 promises the operator.

The market for aircraft in this category has itw own laws. With highly successful sales of the Utility family, from the Do 228 to the Skyservant, Dornier has had ample opportunity to study these laws. The result is the Do 228.

The Wing Section

The two new Dornier models have a wing section that has never been used on an airplane before--if one excepts the TNT test vehicle. The designation of the new wing section is: Dornier A-5. Some prehistory: In previous years during the design stage of a new aircraft a suitable wing section was selected from one of the available wing-section catalogs. The majority of aircraft in use today employ NACA wing sections, which are defined more precisely by a four- or five-digit number. Laminar sections are recognizable by the serial numbers 63 or 64. The necessity of flying with even great fuel economy to save energy forced the development of new "individual" wing sections, sections that were custom designed for a particular purpose and not more or less "good for everything." The development of new specialized sections for particular categories of airplanes started in the early 1970s under the leadership of the recognized American aerodynamic expert Whitcomb. One of the results of his research was a new wing section series, which was given the designation GA(W) and was designed specially for General Aviation. The designation GA(W)-x stands for General Aviation Whitcomb. The first sections of this series are already in use at General Aviation, for example, the GA(W)-1 section, which is used on the Beech Skipper. Starting with the GA(W)-1 section, Dornier investigated the possibilities of further development on behalf of the Ministry for Research and Technology (BMFT). Work began in 1975 and revealed some promising aspects, that is to say, it appeared possible to achieve an improvement in maximum lift and also in the lift-drag ratio. Dornier investigated the effects of a new section of this type in actual flight. For a twin-engined airplane equipped with 2 200-hp engines, with a liftoff weight of 1,814 kg and a wingload of 94.5 kg/m^2, an increase in maximum section lift of 20 percent and in liftdrag ratio during climbing of 4 percent would shorten the takeoff distance by 25 percent, improve the climb gradient on one engine by 32 percent and achieve an increase in range of up to 57 percent. If one compares the effort

which was formerly needed to achieve similar improvements in performance, the great value of this improvement in wing section can be quickly recognized.

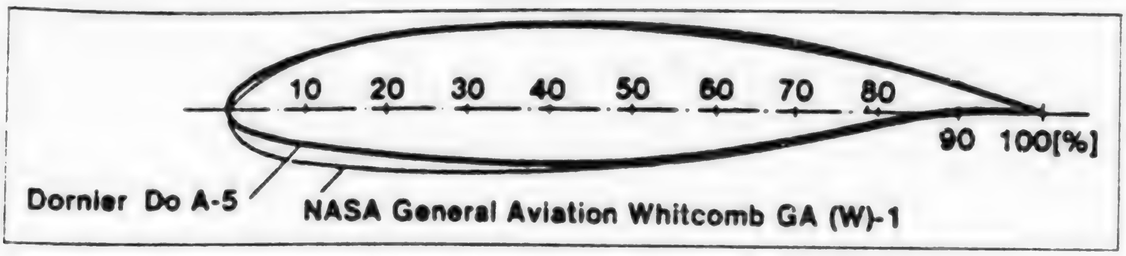
In order to realize the practical benefits of this improved wing section, Dornier first freed itself from the need to use the laminar section. It is true that the drag of NACA laminar sections using the so-called laminar depressions is extremely low, but this cannot be fully utilized in practice due to the intrinsic need for precise construction. There is the additional fact that in a twin-engined aircraft about 40 percent of the free upper surface of the wing is washed over by the propeller's wake, so that air does not pass over it in laminar flow.

Starting with these facts, two measures crystallized at Dornier, which lead to the new section with the desired increase in maximum lift and the sought-for improvement in the lift-drag ratio.

--An increase in the nose radius or the curvature of the nose
--An increase in the curvature at the rear of the wing section

Both these measures are already found in the GA(W)-1 profile, for which maximum lift without and with extended flaps is 0.3 and 0.4 higher respectively than the comparable conventional profiles.

Using the GA(W)-1 section as a starting point, Dornier then began optimizing the wing section, work which was finally brought to completion with the Dornier A-5 section. The A-5 section (see drawing) has a sharper curvature in the nose area and has a smaller nose radius.



As the result of a weight and cost analysis carried out for the new-technology wing, the section thickness was reduced from 17 to 16 percent. The Dornier A-5 section was complemented by a single-slot flap with a depth of 30 percent, the design of which resulted empirically from consideration of experience with flaps for supercritical wing sections. This was possible because both sections have in common a pronounced rearward curvature. In fact, the GA(W)-1 sections were a kind of spinoff from the development of supercritical profiles for aircraft operating close to the speed of sound.

With the development of the A-5 sections, the first and perhaps most important step toward the development of the TNT had been taken. For a number of reasons, Dornier decided on the high-wing method of construction in the design of the Do 228. Naturally, the possibility of taking over a large number of components from the previous Skyservant program spoke in its favor, but independently of this "considerable hereditary burden" there are a number of good reasons in favor of high-wing construction. One of the advantages is that in determining the dimensions

of the propellers from the point of view of efficiency and noise emissions, optimal figures can be sought without having to consider necessary ground clearance. This advantage must not be underestimated when seeking the highest possible overall efficiency.

The Do 228 is the first airplane to be equipped with a new-technology wing. In this respect also the high-wing layout offers advantages in construction, since the wing can be designed solely according to aerodynamic considerations and, for example, does not also have to accomodate the undercarriage.

For passengers, the relatively low-slung fuselage offers easy entrance and exit and a good view of the ground from all seats during flight.

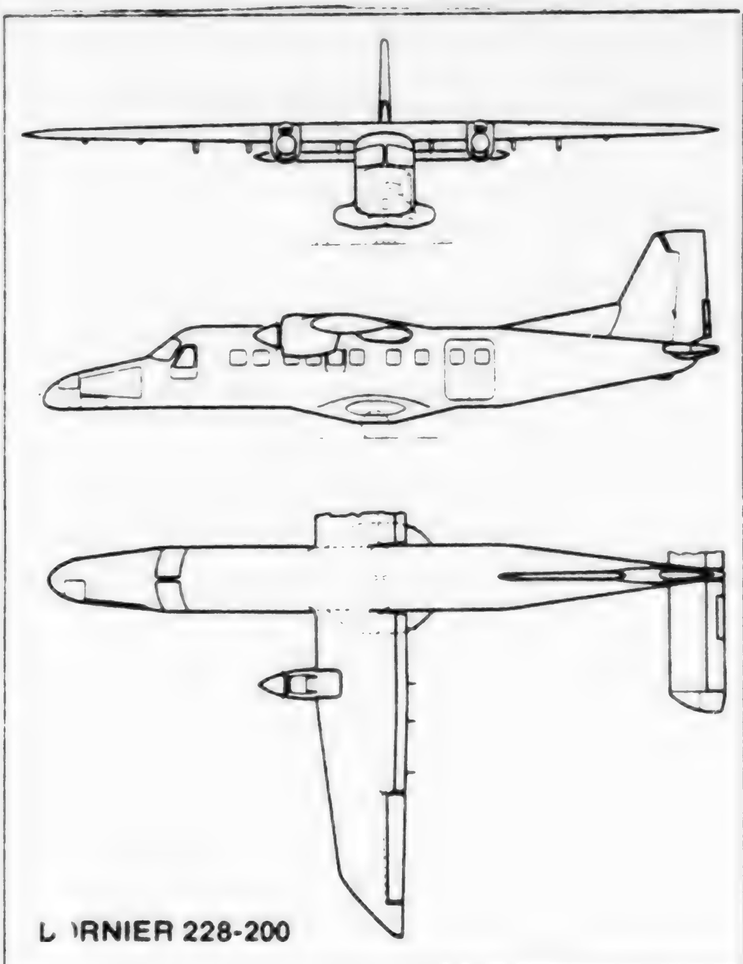
The rectangular fuselage cross-section was adopted from the Skyservant and has proved to be outstanding for an aircraft of this class because of its excellent utilization of space. Unfortunately, this fuselage design does not allow the Do 228 to be equipped with a pressurized cabin. This is not absolutely necessary for the typical applications for which the 228 is designed. In the short term, Dornier is not thinking of developing a new pressurized cabin, but in the course of the program it will certainly follow to supplement the progressive TNT.

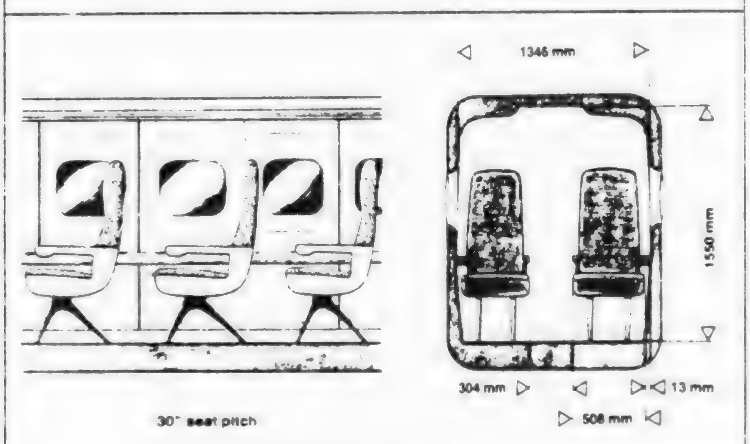
Dornier selected the Garrett AiResearch TPE331-5 turboprop engine as the powerplant; it is known to be economical, nonpolluting and require little maintenance and was restricted to a takeoff power output of 715 shaft hp (ISA [International Standard Atmosphere] + 18° C). From a comprehensive test program using eight different types of propeller, a four-blade, adjustable pitch airscrew from Hartzell emerged as the best compromise and was thus the winner. The propellers can be feathered and reversed. Dornier was able to opt for a relatively large propeller diameter, 2.73 ms, which has a positive effect on both efficiency and on efforts to reduce noise during flight. The overfly noise of the Do 228 can be described as very low at only 78 dBA.

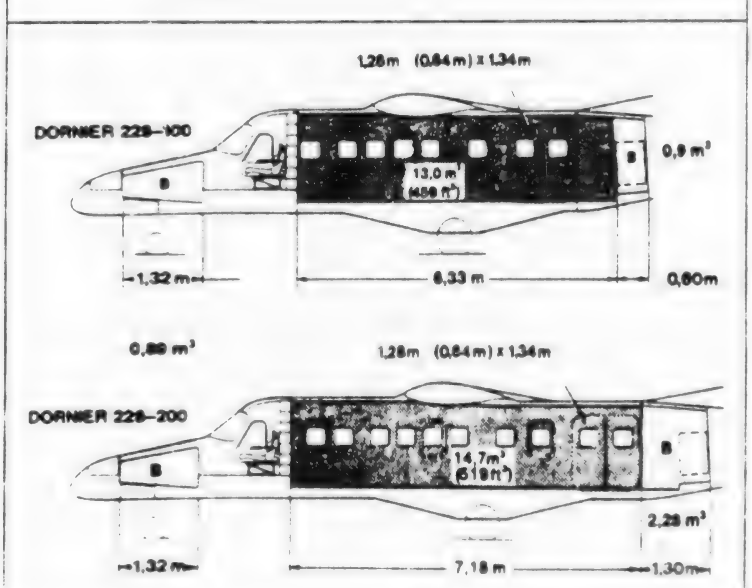
It should be noted that the undercarriage is designed for operation from minimally prepared airfields and it can be fitted with so-called low-pressure tires upon request. The steerable nosewheel is fitted with twin tires.

The multiplicity of possible variations in cabin layout is important for the customer. First of all, there is the choice between the 100- and the 200-version. The difference in cabin length is 6.33 ms in the 100 and 7.08 ms in the 200. Depending on the seating arrangement, the smaller version can carry a maximum of 15, the larger one a maximum of 19 passengers. All seats can be reached easily and comfortably from a central aisle. Even when boarding there should be no "pushing and shoving", due to the large double doors, measuring 1.28 x 1.34 ms, located at the left rear end of the fuselage. There are two compartments for passengers' baggage, at the rear of the fuselage, adjoining the cabin, and in the nose section, directly above the nose wheel (indicated by "B" in the drawing).

If the Do 228-200 is used as a freight carrier, am impressive cargo space of $14m^3$ is available.


DORNIER 228-200


1346 mm
1550 mm
304 mm
13 mm
508 mm
30" seat pitch


1,28m (0,64m) x 1,34m
DORNIER 228–100
0,9 m³
13,0 m³
1,32 m
6,33 m
0,60m
0,86 m³
1,28m (0,64m) x 1,34m
DORNIER 228–200
14,7m³
(519 ft³)
2,29 m³
1,32 m
7,18 m
1,30m

The cockpit is normally intended for operation with two pilots and is accordingly equipped with dual controls. In principle, operation with only one pilot would be possible. Access to the cockpit is either through the cabin or through a separate cockpit door. Vision from both pilots' seats is outstanding.

From the outset the designers' efforts were directed at keeping the time required for the preflight check as short as possible. This principle can be detected everywhere in the design of the systems.

Steering the aircraft is carried out mechanically, as is rudder trimming. Elevators and aileron trimming are designed for electromechanical operation.

The engines are supplied with fuel from two independent tank systems. Each tank system in turn consists of 2 integral tanks per wing, designed for pressure-refuelling, which together can hold 1,125 liters of fuel.

The leading edges of the wings and tailplane are provided with pneumatic deicing equipment, while the engine air intakes are deiced with hot air and the propellers are deiced electrically. A special separate system takes care of deicing the front windshield.

Taking everything together, the Do 228 promises to be an aircraft that has a number of advantages to offer the operator.

--Fuel savings of up to 30 percent through superior wing aerodynamics.

--A rectangular, fully usable, comfortable and spacious cabin with numerous possibilities for use and different arrangements.

--Good performance characteristics when using short and high-altitude airfields and in hot weather.

--A range of up to 1,065 nautical miles (1,970 kms) at maximum load.

--Low operating costs resulting from good fuel comsumption and simple maintenance.

--Independence from ground installations.

--Long cabin life, designed for 30,000 flights without overhaul.

The design and the execution of the 228 program so far have shown that the German aircraft industry is capable of entering the world market in this area with technologically attractive products at realistic prices. It only remains to wish for Dornier that civilian applications are found for this new airplane family inside the FRG as well. Third-level air travel could profit immensely from it.

Dornier Do 228 Data Table

Manufacturer		Dornier	
Model		228-100	228-200
Engines		Garrett TPE731-5 [as published]	TPE731-5
Power	kW	2 x 534 = 1,068	2 x 534 = 1,068
	SHP	2 x 715 = 1,430	2 x 715 = 1,430
Wing Span	ms	16.97	16.97
Length	ms	15.03	16.55
Height	ms	4.86	4.86
Cabin Dimensions			
Length	ms	6.30	7.08
Height	ms	1.35	1.35
Width	ms	1.55	1.55
Empty Weight	kg	2,798	2,908
Weight with Equipment	kg	3,193	3,393
Maximum Weight without Fuel (MFZW)	kg	5,400	5,400
Maximum Fuel Load	liters	2,250	2,250
Maximum Payload	kg	2,207	2,057
Maximum Takeoff Weight	kg	5,700	5,700
Cruising Speed at 10,000 ft.	KTAS [Knots True Air Speed]	233	233
	km/hour	432	432
Economical Cruising Speed at 10,000 ft.	KTAS	179	179
	km/hour	332	332
Rate of Climb on two engines	ft/min	2,050	2,050
	ms/sec	10.4	10.4
on one engine	ft/min	530	530
	ms/sec	2.7	2.7
Service Ceiling	ms	9,020	9,020
Maximum Range at Maximum Payload	km	1,970	1,150
Takeoff Run	ms	415	415
Takeoff Run to clear a 15 meter barrier	ms	525	525

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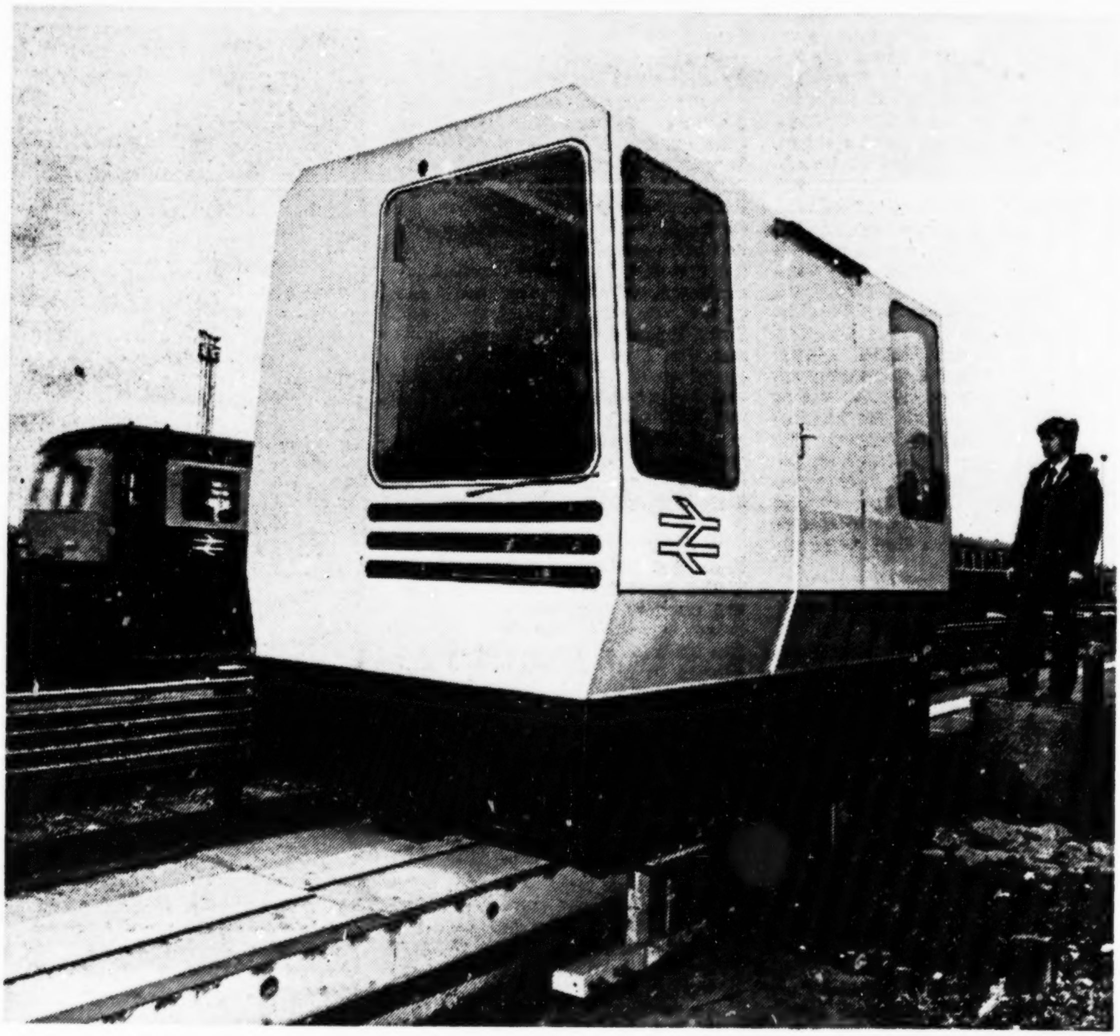
CSO: 3102/372

MAGNETIC LEVITATION VEHICLE

Duesseldorf VDI NACHRICHTEN in German 19 Jun 81 p 16



[Text] This experimental driverless vehicle floats on a magnetic field. It is the prototype of a commuter transportation vehicle, which is to connect the new airport terminal in Birmingham with the railroad station and the National Exhibition Center. The car rides 15 mm above the guide rail, powered by a linear induction motor. The planned commuter service for Birmingham will consist of 3 cars, each with 30 seats and room for 48 standing passengers.

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DATE FILMED

Sept. 29, 1981

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